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High pressure synthesis of BN and BCN crystals and their functionalization

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Hexagonal BN (hBN) and cubic BN (cBN) are known as the representative crystal structures of BN. The former is chemically and thermally stable, and has been widely used as an electrical insulator and heat-resistant materials. The latter, which is a high-density phase, is an ultra-hard material second only to diamond. Recently, some progresses in the synthesis of high purity BN crystals were achieved by using Ba-BN as a solvent material at high pressure crystal growth [1]. Band-edge natures (cBN Eg=6.2eV and hBN Eg=6eV) were characterized by their optical properties. The key issue to obtain high purity crystals is to reduce oxygen and carbon contamination in the growth circumstances. It should be emphasized that hBN exhibits attractive potential for deep ultraviolet (DUV) light emitter [2] and also superior properties as substrate of graphene devices [3]. In this study, the effect of carbon impurity in BN is investigated. Three types of experimental approaches were carried out; (1) synthesis of high purity hBN single crystals and its characterization with respect to residual carbon, (2) high temperature solid state diffusion of carbon into hBN and its characterization, and (3) high temperature annealing of turbostratic B-C-N(t-BCN) compound under high pressure. t-BCN flakes obtained by chemical vapour deposition process was annealed near 3000C and 2GPa so as to become well crystallized.At annealing near 3000C at 2GPa with graphite, carbon incorporation of 1E21/cm3 in hBN was achieved with exhibiting totally different Cathode Luminescence spectra feature with high purity hBN crystals. Since major carbon contribution may affect the crystal structure of the 2-D layers stacking in hBN system, phase stability of BCN ternary phase will be introduced by the experimental results of high temperature annealing. Furthermore, effect of carbon impurity upon the synthesis of wurtzite BN from highly crystalline hBN via martensitic phase transformation will also be introduced.

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